SH 367
A2 S7f

PROGRESS REPORT ON ALASKA FISHERIES MANAGEMENT AND RESEARCH 1957

SEP 1958
LIBRARY
FISH & WILDLIFE SERVICE

SPECIAL SCIENTIFIC REPORT–FISHERIES No. 258

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

EXPLANATORY NOTE

The series embodies results of investigations, usually of restricted scope, intended to aid or direct management or utilization practices and as guides for administrative or legislative action. It is issued in limited quantities for official use of Federal, State or cooperating agencies and in processed form for economy and to avoid delay in publication.

UNITED STATES DEPARTMENT OF THE INTERIOR, Fred A. Seaton, Secretary
FISH AND WILDLIFE SERVICE, Arnie J. Suomela, Commissioner

PROGRESS REPORT ON
ALASKA FISHERIES MANAGEMENT AND RESEARCH
1957

Prepared by
The Staff of the Alaska Region
BUREAU OF COMMERCIAL FISHERIES

Special Scientific Report - Fisheries No. 258

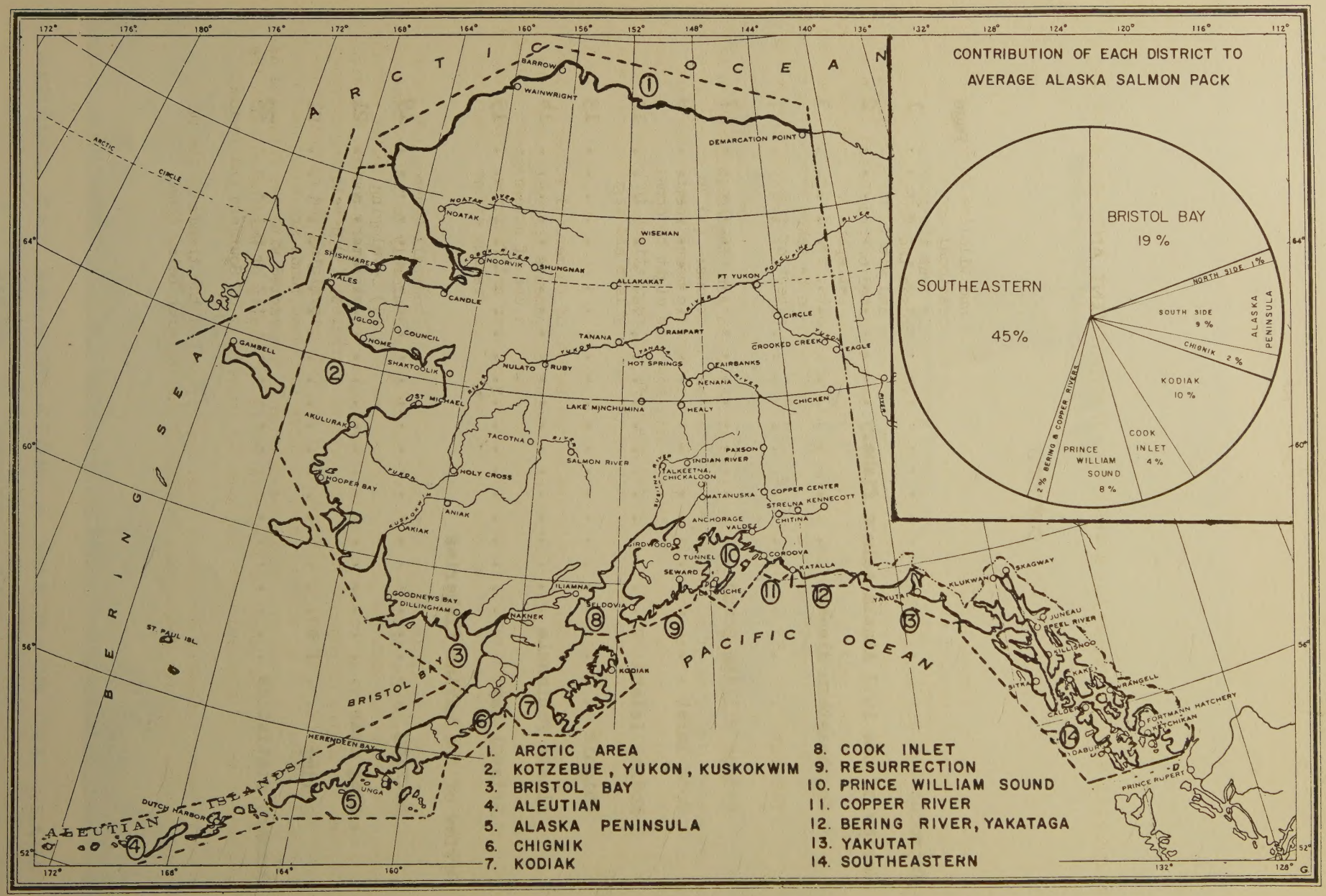
Washington, D. C.

June 1958

COUNTING RED SALMON FROM A TOWER ON THE ALAGNAK RIVER IN BRISTOL BAY

CONTENTS

	Page
Introduction	1
Review of the 1957 Alaska salmon fishery	2
Southeastern Alaska	3
Yakutat	7
Prince William Sound	7
Cook Inlet	9
Kodiak Island	12
Chignik	13
Alaska Peninsula	14
Bristol Bay	15
Review of the marine fisheries	
Herring	19
King crab	21
Shrimp	21
Summary statistics	22



MAJOR REGULATORY DISTRICTS IN ALASKA

PROGRESS REPORT ON ALASKA FISHERIES MANAGEMENT AND RESEARCH, 1957

INTRODUCTION

The Bureau of Commercial Fisheries of the U. S. Fish and Wildlife Service operates in Alaska under the general authority provided in the Congressional Act of June 18, 1926, commonly called the White Act. This Act states very clearly that its purpose is to protect and conserve the fisheries of Alaska. For these purposes the Secretary of the Interior may set apart and reserve fishing areas in Alaska and within such areas may establish closed seasons during which fishing may be eliminated or prohibited as he may prescribe. This authority to limit fishing in any area so set apart and reserved allows the Secretary to (a) fix the size and character of nets, boats, traps, or other gear and appliances to be used therein; (b) limit the catch of fish to be taken from any area; and (c) make such regulations as to time, means, methods, and extent of fishing that he may deem advisable.

In accordance with the purposes outlined in the White Act, the administration of the commercial fisheries of Alaska has three principal functions: (1) To investigate the status of the fisheries resources and determine by scientific means whether they are yielding the maximum harvest and, if they are not, how this might be done; (2) to translate the scientific findings into management measures and regulations in order to achieve the maximum sustained yield; and (3) to enforce the fishery laws and regulations which apply in Alaskan waters.

During 1957 the conservation policies of the Bureau of Commercial Fisheries continued to feature: (1) Even distribution of spawning escapements throughout the runs; (2) preventive enforcement of regulations through extensive use of streamguards as funds permitted; (3) area registration to prevent shifting of gear and fishermen from district to district during the peaks of the run; and (4) control of fishing effort locally to secure satisfactory escapements.

In February 1957 funds became available under the Saltonstall-Kennedy Act for a greatly expanded research program. This program is applied closely to the problems of managing the fisheries with the principal objectives of: (1) Developing better methods of forecasting the runs to be expected; (2) determining the migratory routes, migratory rates, and the mixing of populations in the several fisheries; (3) developing improved methods of obtaining catch and escapement data; and (4) determining the natural causes of mortality in the life of salmon. Part of these increased funds are being used directly by the Bureau of Commercial Fisheries; the balance is contracted with the Fisheries Research Institute and the School of Fisheries of the University of Washington, with the Alaska Department of Fish and Game, and with the University of Southern California.

The summary following provides a brief description of the trends in the major Alaskan fisheries and the preliminary results of the research being done.

REVIEW OF 1957 ALASKAN SALMON FISHERY

The 1957 Alaska salmon pack was increased considerably in September when fall chums appeared in substantial volume in Southeastern Alaska and contributed an additional 100,000 cases. The pack for 1957 was approximately 2,457,000 cases (fig. 1). The catch also included an additional 1,300,000 fish, primarily sockeyes, which were cured or frozen by freezer ships.

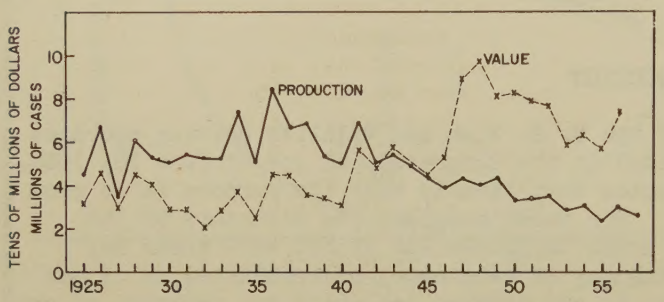


Figure 1.--Production and value of canned Alaskan salmon

The principal reason for this year's poor catch of salmon was the universal "failure" of pink salmon runs throughout the Territory. Although satisfactory escapements occurred in 1955 on the south side of the Peninsula and at Kodiak, Port Dick, and the lower portion of Southeastern Alaska, the pink salmon return was disappointing everywhere. The seine catch of nearly three million fish offshore from the west coast of Prince of Wales Island in late July and early August was an unusual development. Apparently competition between gear was so heavy that few seiners made good profits. Figure 2 illustrates the contribution of pink salmon to the total Alaskan salmon pack in 1957 (30 percent) as contrasted to the long-term average (50 percent).

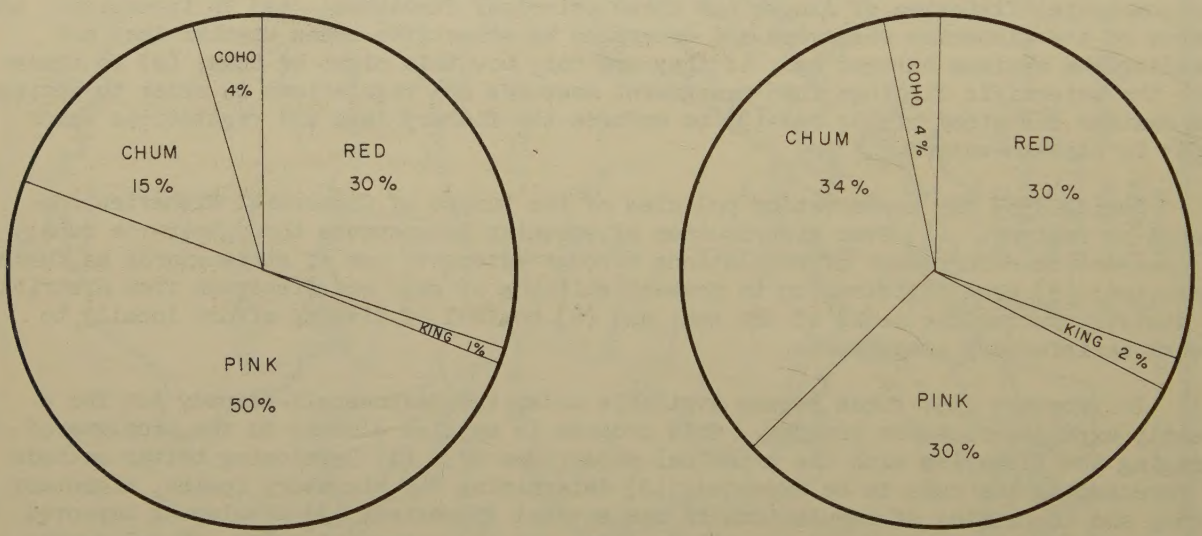


Figure 2.--Contribution of each species to the Alaskan salmon pack; long-term average on left, 1957 percentage on right

Fortunately, 1957 was an above-average year for chum salmon, and this helped somewhat to offset the lower abundance of other species in the Nushagak River, South Peninsula, Cook Inlet, Kodiak, Prince William Sound, and some sections of Southeastern. This year's pack was made up of 34 percent chums compared to the usual yearly average of 15 percent.

The sockeye catch failed for the second successive year on the Nushagak River, but this was partly compensated by a productive week on the Kvichak starting July 8. The

False Pass sockeye catch was very poor, and abundance was off at Port Moller also. Previously stable Cook Inlet produced half its normal pack of sockeyes for the first time in many years. Sockeye runs elsewhere in the Territory were about average at recent-year levels.

The king and coho fisheries were not distinguished by unusual features except that kings appeared early in Cook Inlet and so largely escaped the June effort, and cohos were unusually fine in quality and size throughout the season in Southeastern but were in scant supply in streams of the Gulf of Alaska, including the Copper River.

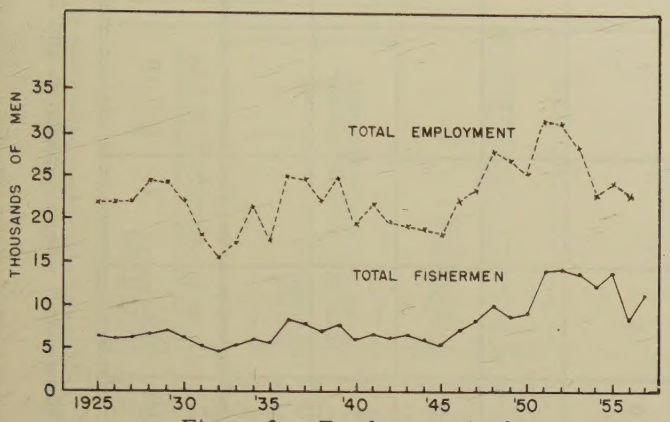


Figure 3.--Employment in the Alaska salmon fishery

There is some consolation in the fact that escapements of all species, with few exceptions, were much better in both size and distribution than the small catches would indicate--this despite scant precipitation and low stream flows that approached drought conditions in some districts. Given favorable natural survival, the progeny of the 1957 escapements should be adequate in most cases to support substantial fisheries in the years of their return.

The number of fishermen and types of gear used in the 1957 fishery are shown in figure 3 and table 1.

SOUTHEASTERN ALASKA

The pink salmon pack of 405,000 cases (fig. 4) reflects the general failure of this species. Although Southeastern produced 150,000 cases more than this in 1955, the current pack does exceed the low pack of pinks in 1953 by 50,000 cases. Twenty-three plants operated this year, some of which represented consolidations of two or more companies.

There were two outstanding features of the 1957 pinkrun: (1) The outer section of the South Prince of Wales Island district experienced an unusually heavy offshore fishery. Of the eight million pink salmon taken in all of Southeastern Alaska, outer South Prince

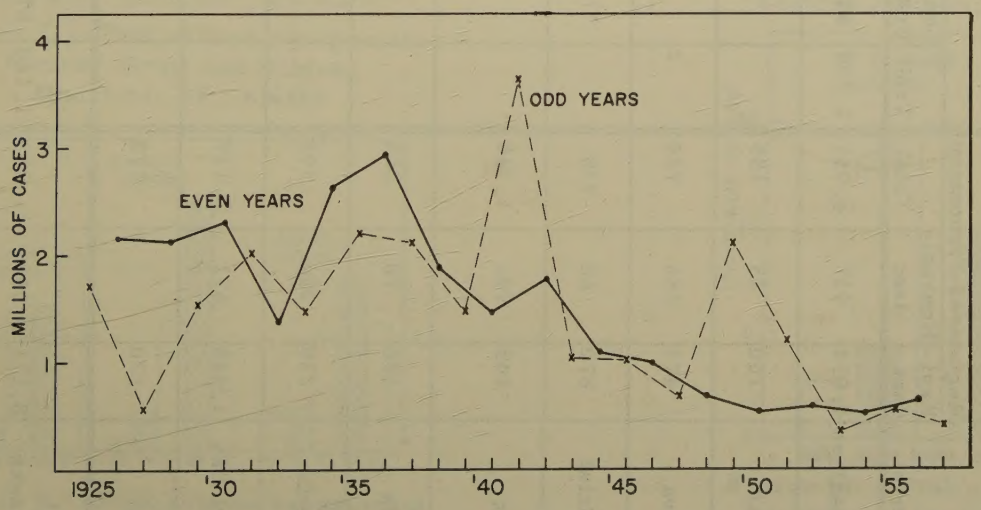


Figure 4.--Pink salmon pack Southeastern Alaska

Table 1.--Fishermen and fishing gear registered in Alaska, 1957

District	Registered Fishermen			Registered Units of Gear												
	Resident	Nonresident	Total	Troll	Long line	Drift Nets	Set Nets	Beach Seines	Purse Seines	Herring Seines	Herring Pound	Trawlers	Clam Diggers	Crab	Other	Traps
Southeastern	4,014	937	4,951 1/	1,138	40	King 208 Red 276 Coho 294	King 21 Red 25 Coho 25	10	431	9	1	10		7	2	123
Yakutat	160	25	185				King 52 Red 180 Coho 185									
Cordova	473	256	729	2		King 29 Red 588 Coho 403	Red 30 Coho 11	165					146	9		11
Cook Inlet	870	68	938		17	King 332 Red 329 Coho 84	King 444 Red 483 Coho 147	85					1	King Cr. 4 58		45
Kodiak	645	701	1,346			Red 12	King 1 Red 104 Coho 1	34	410	6			57	King Cr. 9 50		22
Chignik	152	70	222				Red 2	60	61							
Peninsula	239	354	593			King 62 Red 98 Coho 62	King 3 Red 57 Coho 3	23	118							20
Bristol Bay	1,448	671	2,119			King 923 Red 1354 Coho 978	King 43 Red 256 Coho 157									
Yukon	170		170				King 144								Fish Wheel 5	
TOTAL All Alaska	8,171	3,082	11,253	1,140	57	King 1554 Red 2657 Coho 1821	King 708 Red 1137 Coho 529	377	1,020	15	1	10	204	King Cr. 13 124	7	221

1/ Includes 1,125 resident trollers and 155 nonresident trollers; also includes 452 resident sport fishermen and 22 nonresident sport fishermen.

of Wales Island produced approximately three million--over 37 percent. The fish were so concentrated in the vicinity of Cape Addington that the greatest portion of the catch was taken by mobile gear within an area of less than 15 miles along the coast. (2) The relative escapement from the total run was surprisingly good. There were gains over the parent year in both early and middle run streams. However the overall late escapement was less than in 1955 and was not good. The escapements for each of the districts in Southeastern Alaska are shown in figures 5, 6, 7, 8, 9, and 10. The geographic locations of the districts are shown in the map (fig. 11).

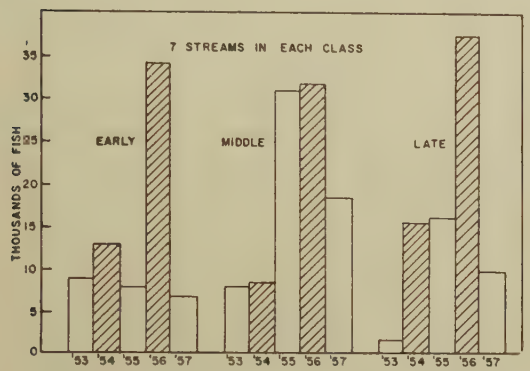


Figure 5.--Pink salmon escapement Southern and Clarence Strait Districts, SE. Alaska

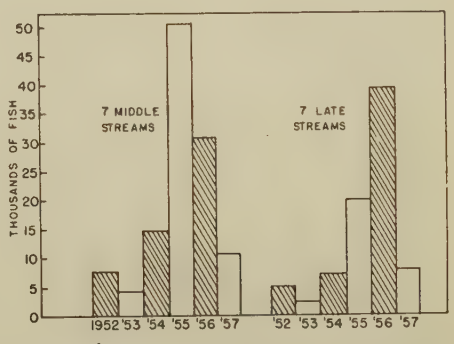


Figure 6.--Pink salmon escapement South Prince of Wales Island District, SE. Alaska

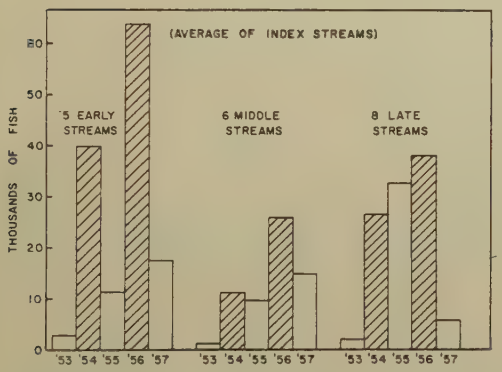


Figure 7.--Pink salmon escapement Sumner Strait and Stikine Districts, SE. Alaska

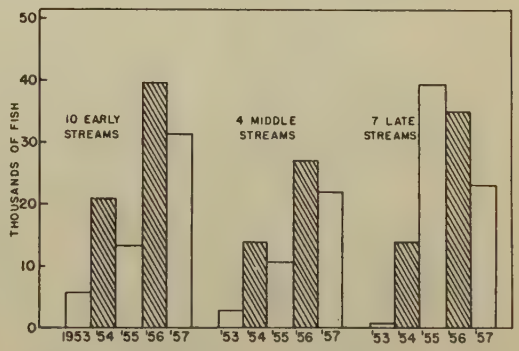


Figure 8.--Pink salmon escapement Eastern District, SE. Alaska

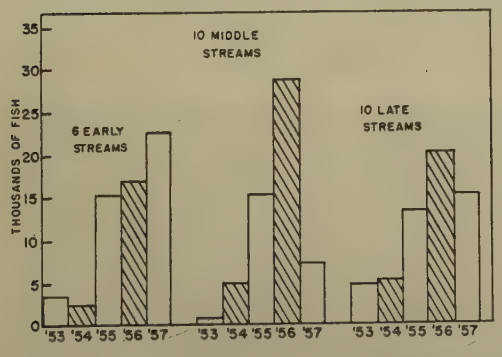


Figure 9.--Pink salmon escapement Western District, SE. Alaska

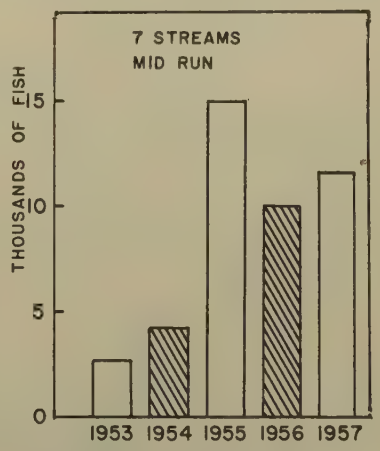


Figure 10.--Pink salmon escapement Icy Strait District, SE. Alaska

The chum run was relatively substantial throughout the season, giving satisfactory proportionate escapement and a pack of 363,000 cases. To offset the lack of fish of the summer season, there was unusual activity in utilizing the fall catches of both seines and gill nets, with the result that over 100,000 cases were processed, plus a substantial increase of frozen products.

The newly established gill net fishery from Red Bay to Lake Bay on the northeast coast of Prince of Wales Island produced somewhat less than hoped. Contrary to expectations, the Lake Bay fish were not intercepted, resulting in an underutilization of these sockeye. Portland Canal was more productive in its first year of gill netting, accounting for 110,000 salmon, primarily chums. In comparison, the long established seine fishery in Portland Canal accounted for only 20,757 fish, over half of which were pink salmon. The escapement in all American tributaries to Portland Canal was satisfactory.

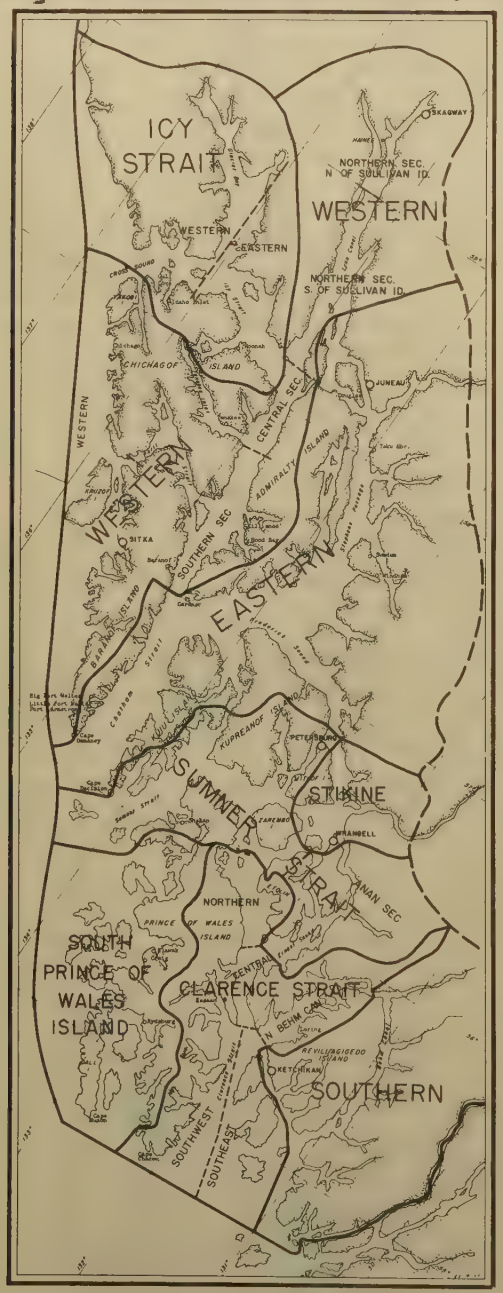


Figure 11.--Regulatory Districts Southeastern Alaska

The several gill net fisheries made a significant contribution to the 1957 pack. Gill net caught chum salmon, alone, numbered about 500,000 fish and made up about 20 percent of the total production in Southeastern Alaska.

Two of the research projects being conducted in Southeastern Alaska are directed toward developing reliable means of predicting the abundance of adult pink salmon. One method involves obtaining an index of abundance of the young fry migrating from their parent streams. The second method, perhaps more desirable because it eliminates consideration of freshwater and early saltwater mortalities, is an estimate of abundance of the fingerling in marine feeding areas and migration routes.

A total of 12 fry sampling stations was operated during the spring of 1957. They were located, with few exceptions, on streams in the southern inside waters of the Panhandle. Rectangular fry traps, thoroughly tested in 1956, were used to establish a more reliable index of abundance. Comparative data are available for only 4 streams; in 3 of these the fry migration was much larger in 1957 than in 1956, and in the other it was very low. Among all of the streams the migration was judged to be good to excellent in 7 and fair to poor in the balance. The largest catches and estimated migrations occurred at Anan Creek, Naha and Wilson Rivers, and Herman Creek.

The enumeration of the fingerling pink salmon was conducted at 115 fish traps, where the watchmen cooperated by keeping daily records of young salmon observed within the pots and spillers. In general, the records obtained provide a relative index of abundance. This was the third year in which an index of fingerling abundance was compiled, and adult returns for two years are now available for analysis. The abundance index, consisting of

the average number of fingerling per observation, was the lowest of the past three years, with only 518 as compared to 1,181 in 1955 and 796 in 1956. For the first two years the fingerling index provided consistent results. The large fingerling appearance in 1955 produced a case pack of 544,221 and a good spawning ground escapement in 1956. The considerably smaller showing of fingerlings in 1956 produced 404,250 cases and a smaller spawning escapement in 1957.

At the Little Port Walter field station the complete counts of pink salmon spawners and emerging fry continued. The survival of fry from 1956 was the lowest on record--only 0.2 percent. In addition, special pens are being designed to hold spawners and eggs under controlled conditions in order to determine more precisely their temperature, oxygen, and other requirements.

No proven method of forecasting has been developed for pink salmon in Southeastern Alaska and the evidence at this time is conflicting. If survival from the 1956 spawning is normal, a run that will produce a million or more cases may occur. If, however, the evidence of scarce fingerlings in 1957 is reliable (and we have had too little experience with this to know), then a much lower production may occur in 1958.

The study of the effects of logging on salmon in Southeastern Alaska was continued. This is a contract study being performed at Hollis by the Fisheries Research Institute in close cooperation with the U. S. Forest Service. Data were obtained on salmon spawning, bottom fauna, silting, flow, oxygen, and other factors affecting the survival in three streams. One of these streams has been logged, one is about to be logged, and one will not be logged. Much of the work by the Fisheries Research Institute to date has been to devise and test experimental methods, and no conclusions are possible. However, a report by the U. S. Forest Service indicates that the logging in the Hollis area has had very little effect on stream flow, temperature, or silting to date.

A new project on the tagging of pink and sockeye salmon was begun off the west coast of Prince of Wales Island under contract with the Fisheries Research Institute. Of the 17,025 salmon tagged, 16,525 were pinks. By October 15, 36 percent had been recovered --one-fourth of them from Canadian waters. The recoveries in Alaska were mostly from the fishery and streams on the west coast of Prince of Wales Island.

A second new project for the year was to compile a comprehensive catalogue of all salmon streams in Southeastern Alaska. This project is intended to bring together all data on the physical characteristics of the streams and the history of the salmon escapements.

YAKUTAT

The major fishery of the area, sockeyes of the Situk River, is well stabilized with both catch and escapement holding up well. The situation is not so fortunate on some of the lesser, outlying streams where runs seem to be suffering from overfishing. As an initial corrective measure, closure markers will be moved downstream to enlarge the area of sanctuary in such streams.

Cohos are normally an important species in all Gulf of Alaska coastal streams but were in short supply throughout the district in 1957 despite unusually favorable weather.

PRINCE WILLIAM SOUND

Prince William Sound reopened in 1957 after a complete closure of the parent pink salmon year in 1955. The pink run was very poor throughout the season, producing a pack of 35,000 cases (fig. 12). Individual fish were of fair size, averaging 18 to the case. The largest portion of the pink pack was obtained from the eastern part of the district.

Escapement was about 17 percent of the parent year, and only a few streams received an adequate number of spawners.

Chum production of 75,000 cases accounted for 68 percent of the district's total pack. Escapement was excellent and well above that of recent years for this species. Many streams which normally have only pinks had good numbers of chums. A surplus of spawners provided a fall fishery in Port Fidalgo, and 158,000 good quality chum salmon were taken in four days during the first week of September. There was a relatively good run and catch of Eshamy reds (fig. 13). Satisfactory escapement did not occur until late in the season when fresh rains after a long dry period enabled schooled sockeyes to ascend to the lake.

In the spring, Copper River red salmon escapement and catch were normal. Observations indicated better than average escapement in the upper tributaries but in the lower streams it was only fair. The condition of the run of summer reds was also average and a fair escapement was apparent. Throughout the season good weather contributed to the success of the catches (fig. 14), and the resulting pack of 54,000 cases was slightly under the annual average of 56,000. The run, pack, and escapement of both cohos and kings were about half normal.

Research in this district is concerned primarily with developing methods of predicting the abundance of pink and chum salmon. Three methods are being explored.

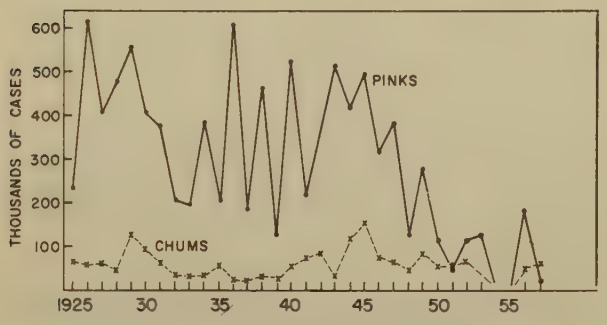


Figure 12.--Prince William Sound salmon production

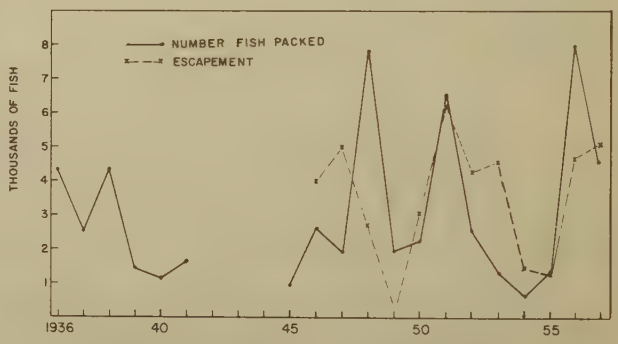


Figure 13.--Eshamy reds pack and escapement

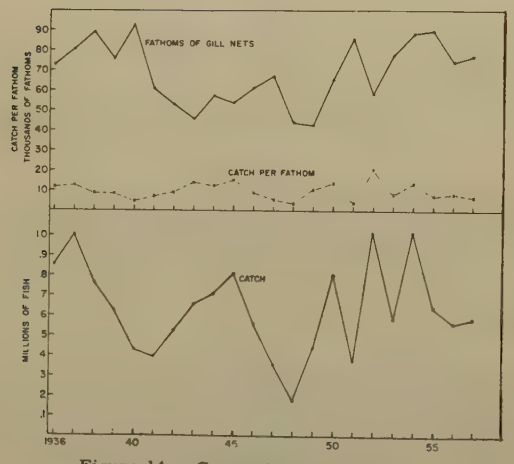


Figure 14.--Copper River red salmon catch, effort, and gear

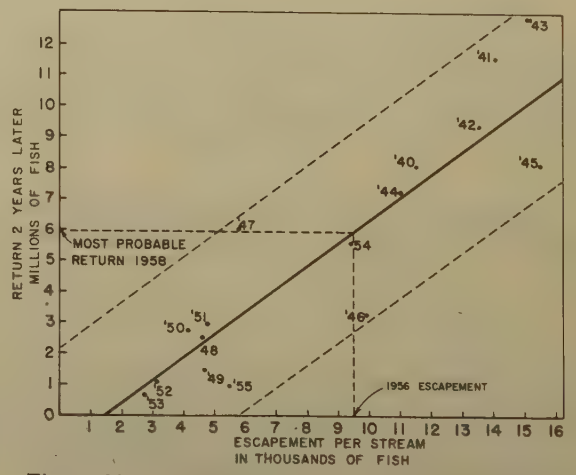


Figure 15.--Relationship of escapement to return, 70 key pink salmon streams, Prince William Sound

1. Relation between adult spawning pink salmon and the return two years later.--Records of the pink salmon catch and escapement in Prince William Sound show a good correlation between the number of spawners and the size of the run in key streams two years later (fig. 15). Using this trend line, a poor run was predicted for the Sound in 1957. The size of the run was even smaller than expected.

Figure 16.--Fry traps used to sample downstream migrants

The 1956 escapement was better--9,500 fish per key stream. Therefore, the most probable return in 1958 is 6 million fish, or about equal to the 1956 run. The odds are 2 to 1 that the return will be between $4\frac{1}{2}$ and $7\frac{1}{2}$ million fish, and there is only 1 chance in 20 that the return will be greater than 9 million or less than 3 million fish. This is the most reliable forecast for 1958 now available.

2. Enumeration of pink and chum salmon fry.--An extensive fry sampling program initiated this year in the Sound was concerned primarily with devising trapping techniques and solving problems of sampling the intertidal areas. Progress and results so far include: Fry traps (fig. 16) were fished at 8 locations in Prince William Sound throughout the migration; fry migration occurred during all hours of the day but was greatest at night; the proportion of fry captured by traps ranged from 2.2 to 13.3 percent as indicated by marking and recovery experiments and stream flow studies; digging techniques using a square yard quadrat sampler were developed as a means of sampling fry in the intertidal areas. No data from these studies can be used to forecast the run for 1958.

Problems yet to be solved include: Determining the number of streams to sample to obtain a reliable estimate of fry abundance for the entire Sound, effects of high tides on trap location and efficiency, time and extent of sampling necessary in intertidal areas, and improvement of fry marking techniques.

3. Distribution and abundance of fingerling pink salmon.--This season emphasis was placed on testing methods of capture of fingerling salmon. Beach seines, bottom trawls, and small-mesh gill nets proved ineffective as fingerling sampling gear. High-speed, meter-size tow nets were the most successful devices tested and were used to systematically sample Galena Bay and Port Gravina areas. Catches were low, and the absence of larger size fingerling indicates that they either move out of the study area on reaching a certain size or that they are able to avoid the nets. A practical method of determining the abundance of fingerling salmon in the open waters of the Sound has yet to be devised.

Under contract to the Fish and Wildlife Service, the Fisheries Research Institute tagged salmon at 11 locations scattered throughout the Sound. A total of 4,176 salmon including 3,320 pinks, 573 chums, 184 reds, 88 cohos, and 11 kings, was tagged. On September 26, 688 recoveries (17 percent of those tagged) had been returned, including 323 from the Prince William Sound fishery, 343 from the Prince William Sound spawning grounds, 16 from the Cook Inlet fishery, and 6 from the Copper River fishery. One of the outstanding features of the early returns was the evidence of considerable wandering within Prince William Sound.

COOK INLET

Cook Inlet red salmon production fell to an all-time low during 1957, probably reflecting damage wrought by the vast increase in gear and catch during the parent cycle

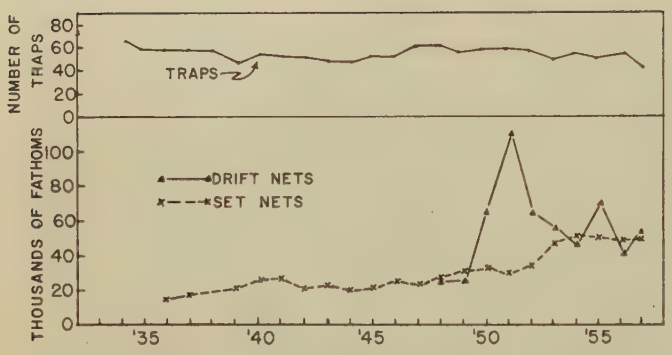


Figure 17.--Cook Inlet red salmon gear operated 1932-1957

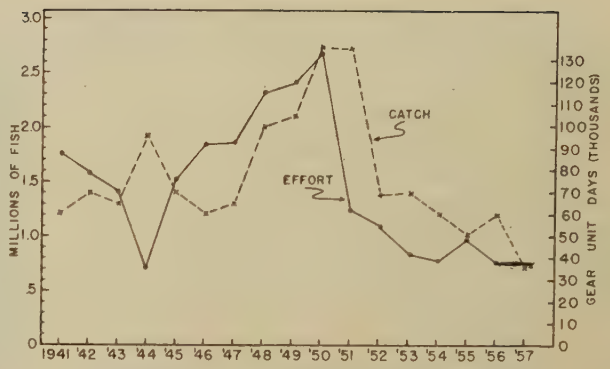


Figure 18.-- Cook Inlet red salmon catch and fishing effort

years. The drift net fleet increased slightly while shore gear remained about the same (fig. 17). Thus, area licensing and the gear-time table succeeded in holding fishing effort to the 1956 level (fig. 18) but did not bring about the decrease necessary to achieve adequate conservation. Escapements (fig. 19) were light to the major spawning systems and extremely poor in the minor systems. Distribution of escapement throughout the season was uneven.

Pink salmon runs were poor in this off-cycle year and correspondingly light escapements occurred. Chum runs reached unprecedented strength resulting in a record pack of 127,950 cases. Escapement of the latter species was considered good, except to streams of the Outer District where streamguard protection was inadequate to control illegal fishing activity.

The king salmon pack of 13,900 cases was about half of normal. It is likely that the run came in earlier than usual. Opening season catches were made far inside Cook Inlet and dropped off sharply after a few days.

Research activities in the Cook Inlet District were concentrated on determining the migratory routes, time of red salmon runs, and on devising methods of counting the escapement of this species in the turbid glacial rivers that are typical of this area.

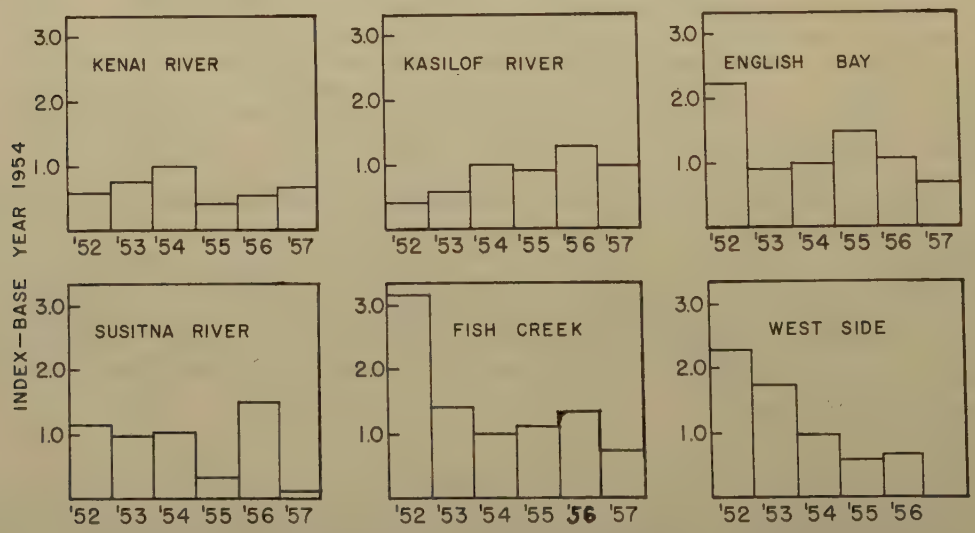


Figure 19.--Cook Inlet red salmon relative escapements

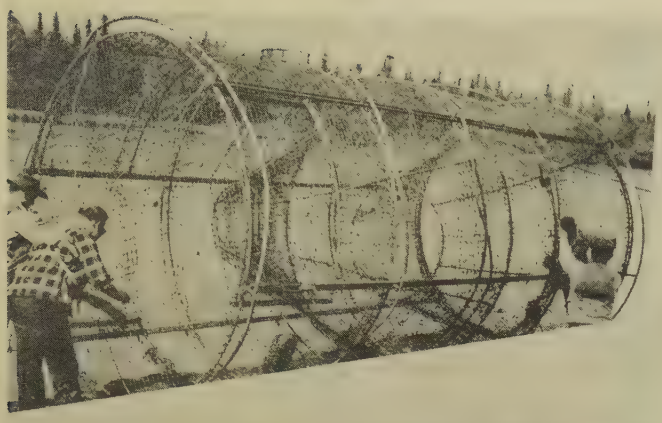


Figure 20.--Fyke net used in sampling runs

A program of test-fishing with large metal fyke traps which was started this summer on the Kenai River promises to be a satisfactory method of obtaining an index of the escapement of red salmon in turbid glacial rivers (fig. 20). Two of these traps which fished throughout the 1957 red salmon season in the Kenai River clearly indicated the relative abundance of fish in the river from day to day. The effects of the commercial fishery on the run are reflected in the reduction in numbers of fish taken in the fyke traps after each open fishing period (fig. 21).

Further refinements of this test-fishing technique will enable us to determine the rate of catch of Kenai red salmon by the fishery.

During the test-fishing operations, 2,246 red salmon were tagged, and intensive stream surveys for tag recovery were conducted throughout the Kenai River system. The objectives were to determine whether the runs headed for the various tributaries pass through the fishery as a group or subpopulation. If distinct subpopulations can be identified, it may be possible to either protect or more fully utilize certain of the runs.

Of the tags recovered to date, 58 percent have been returned from the Russian River, 12 percent from the Kenai, 8 percent from Moose Creek, 8 percent from Kalifonski and Salamatof Beaches, and the remainder from scattered locations in Cook Inlet. Further analysis of the data must wait until all tags are recovered.

Red salmon have been counted at the peak of spawning in certain clear-water sections of Cook Inlet streams each year since 1952 to provide an index of their abundance.

This year every accessible clear-water section of stream in the Kenai River system was surveyed from the air and on the ground several times during the red salmon season. When combined with other studies, these repetitive count data may provide a basis for determining the extent and frequency of counts needed in the future to obtain a reliable index of the total escapement.

Tagging was also conducted along the periphery of Cook Inlet by the Fisheries Research Institute under Fish and Wildlife Service contract as part of an overall study of the timing and rate of migration of red and pink salmon.

About 1,500 salmon were tagged in the open waters of the Inlet. Preliminary analysis of the tags recovered to date shows that some reds tagged in late June, and pinks and chums tagged in mid-July, migrated from the tagging sites at Seldovia Bay and Chisik Island to the Prince William

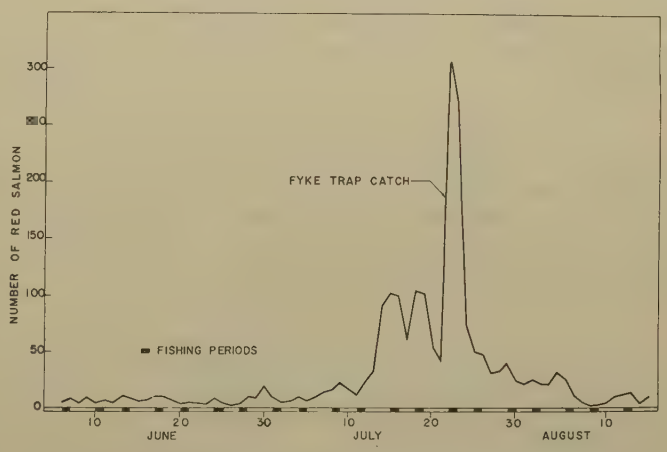


Figure 21.--Kenai River test-fishing catches in relation to commercial fishing periods

Sound and Kodiak areas and as far as the Peninsula district. However, the bulk of the recoveries have been from the Cook Inlet fishery.

Also under support of a Fish and Wildlife Service contract, the Fisheries Research Institute of the University of Washington, has undertaken a study of sea lions and hair seals in the Gulf of Alaska. Before any quantitative conclusion as to the role of sea lions as predators can be made, their numbers and centers of abundance must be known. With this consideration foremost, the program of the Fisheries Research Institute has been to locate the rookeries and to develop suitable methods for census.

Studies were made of 17 major rookeries in the area from Prince William Sound to the eastern Aleutian Islands. By a system of repeated aerial surveys and counts from aerial photographs, the sea lions' summer populations have been estimated as 78,500. It was further learned that seasonal fluctuations occur in abundance on the rookeries.

This study will provide the basis for more detailed investigations and for the establishment of control measures that may be required.

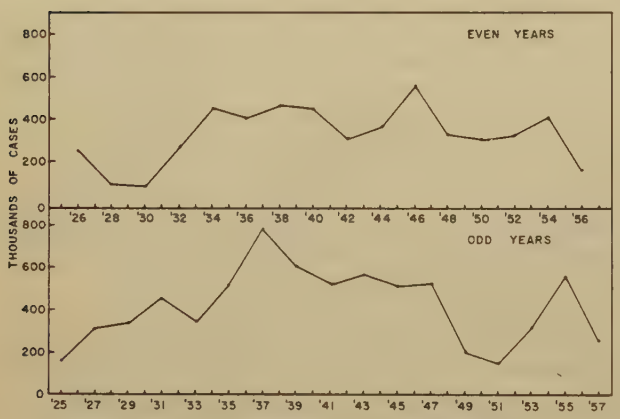


Figure 22.--Kodiak pink salmon pack

KODIAK

The Kodiak pink salmon runs of 1957 were less than expected in light of the favorable escapement during 1955. In spite of the unusually large amount of gear attracted by prospects of a good run, the pack was only 227,000 cases (fig. 22). Survival of the 1955 escapement must have been poor because escapement distribution appeared to be excellent in many streams in that year.

Although a drop in pink escapement occurred during 1957, volume did not appear to be dangerously low in the larger streams, and distribution was generally good. The small streams were poorly seeded, however, due in part to the universal scarcity of pink salmon and also to the unprecedented dry season which retarded, or in some cases prevented, escapement. Both 1956 and 1957 have been characterized by weakness in the late runs, a situation which must be corrected in future regulation.

Combined weir counts for the Alitak District red salmon lakes dropped to 78,947, the lowest on record. Nevertheless, this escapement represents 71 percent of the red salmon run in that district, thus assuring relatively even distribution of a minimal seeding.

The red salmon count through Red River weir during 1957 was 161,192. This is a three-fold gain over the parent cycle of 1952.

The Karluk Lake run for 1957, as reflected by the catch, although low, was higher than in 1956 (fig. 23). The

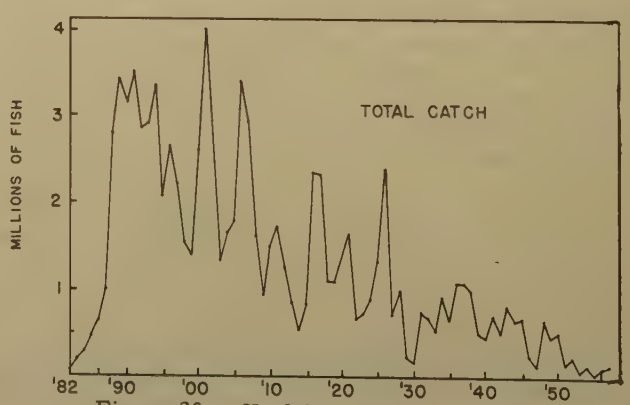


Figure 23.--Karluk red salmon catch

escapement of 220,675 red salmon was well distributed over the season as a result of the policy designed recently to bolster the weak mid-portion of the run. The research program at Karluk Lake is a long-term investigation of the causes of changes in survival rates of young red salmon during the freshwater stages. In past years the work at Karluk Lake has been principally concerned with gathering basic data on numbers of adults entering the lake, their age, length, and fecundity, as well as on sampling of the lake residents.

In 1957 the research was expanded to include studies on survival, or mortality in the spawning streams. Groups of adult salmon entering streams were counted, tagged, and followed through their life spans in the streams.

The gravel of the spawning beds was sampled to determine eggs deposited per unit area in the streams under study. It is planned to enumerate the fry emerging from these streams in the spring.

At Bare Lake a detailed investigation of the effect of the addition of commercial fertilizer on survival of red salmon has been under way since 1950. Nitrate and phosphate fertilizer was added annually from 1950 through 1956. An increase in the growth rate of young lake resident red salmon has been observed, but the general results have been inconclusive. Because it is small and shallow, Bare Lake is not typical of important red salmon producing lakes. Other factors besides food production for the lake residents may be instrumental in the freshwater survival of red salmon.

Bare Lake was not fertilized in 1957, but research was continued on conditions in the lake and on the biology of the young salmon. Observations on Bare Lake will be continued for as long as is necessary to serve as a check and to substantiate results already obtained under fertilized conditions.

CHIGNIK

The 1957 red salmon run, though not as good as 1956, does not compare unfavorably with the preceding nine-year average (fig. 24).

Fishery management relied successfully on an extended closed area at the mouth of the Chignik River and a relatively fixed weekly schedule of 12-hour fishing periods to achieve its objective of obtaining a more uniform escapement of spawning stock throughout the entire run. The escapement percentage of the total run, especially during the heavy fishing period from mid-June to mid-July was satisfactory (fig. 25). Substantial escapements from each segment of the run should contribute materially to increased and steadier future production.

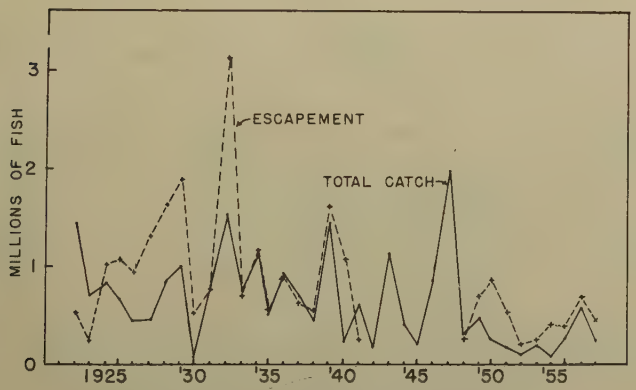


Figure 24.--Chignik red salmon catch and escapement

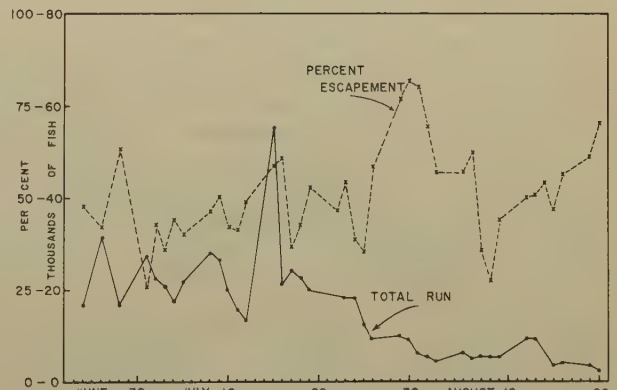


Figure 25.--Relation of Chignik red salmon escapement to total run, 1957

Rehabilitation of the currently nonreproductive pink and chum salmon streams in the Chignik area remains a serious problem. Correction requires intensification of enforcement.

ALASKA PENINSULA

The Peninsula pink salmon pack hit an alltime low of 29,000 cases in 1957.

Good abundance of chums, which had a pack of almost 125,000 cases, compensated somewhat for the pink shortage. Poor production during the summer season kept all canneries and gear in the race for fall fish, the season for which commenced August 19.

The False Pass seiners and traps caught few red salmon despite remarkably calm weather.

Even though a more liberal fishing time was granted, escapement was good into the Bear and Sandy Rivers. It is felt that a continuous stationary patrol of the closed area at the mouth of Bear River contributed materially to the good escapement.

During 1957 the Fish and Wildlife Service conducted the first major research program on the Alaska Peninsula in over 30 years. Pink salmon were tagged in the vicinity of the Shumagin Islands for the purposes of learning migration routes, rate of movement, and the timing of the runs in relation to the fishing season.

Although tag returns are incomplete, some of the more outstanding results of the Shumagin tagging have become apparent. Of 5,500 pink salmon tagged, a recovery of about 35 percent is anticipated. The majority of the fish tagged were apparently destined for local streams, since 94 percent of the tagged pink salmon recaptured were taken within the boundaries of the Peninsula district (fig. 26). Perhaps the most surprising result is the easterly trend of the migration as shown by the eastward extent of the recovery pattern and also by the fact that as yet no recoveries have been reported from the area west of Pavlof Bay.

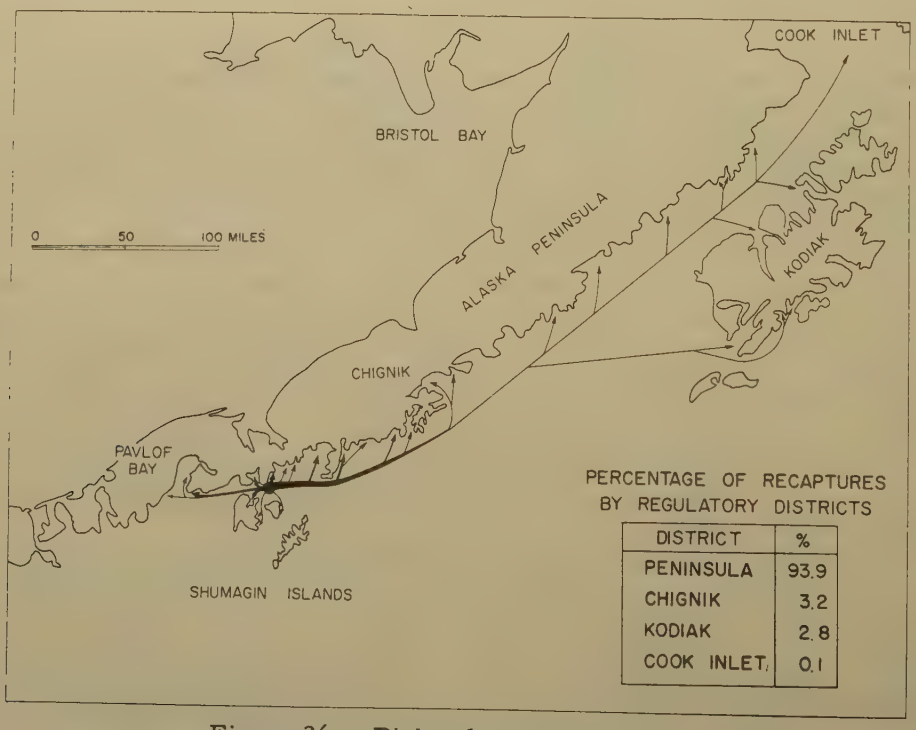


Figure 26.--Pink salmon tag recovery pattern Shumagin Islands tagging - 1957

BRISTOL BAY

As anticipated, the 1957 sockeye production of Bristol Bay fell below that of 1956. However, the pack of 472,000 cases (fig. 27) plus 900,000 fish to freezers is not out of line with recent production, although the Nushagak run fell considerably short of expectation. With fishing effort almost doubled over that of 1956, it was necessary to severely restrict the amount of fishing time to obtain necessary escapements.

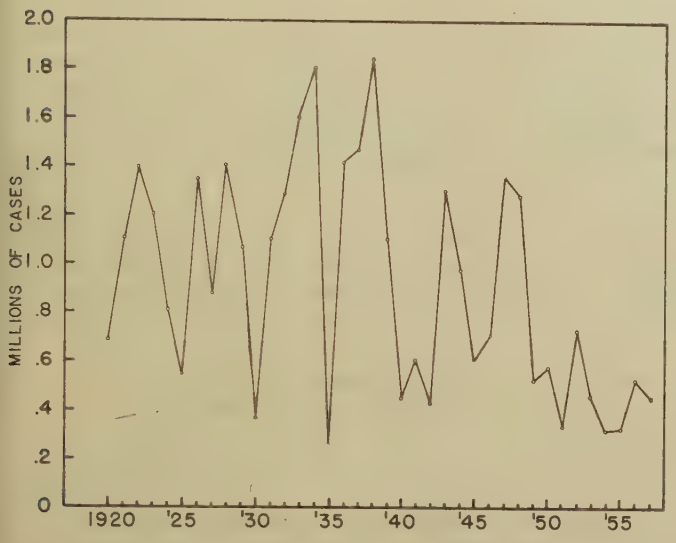


Figure 27.--Bristol Bay red salmon production

Escapement into all major rivers was counted from towers or weirs. Thus the escapement data plus the catch data provides a good estimate of the total run and the proportion caught. Comparison of catch and escapement for the major systems is as follows:

	Catch	Escapement
Togiak	37,967	32,000
Nushagak	539,392	465,000
Kvichak-Naknek	4,648,673	3,729,000
Egegik	789,875	340,000
Ugashik	362,145	205,000
Total	6,378,052	4,771,000
Percent	57%	43%

King salmon fishing on the Nushagak has steadily increased in intensity over the past several years and produced a record catch of 73,142 fish during 1957. It will be necessary to reduce weekly fishing time in succeeding years to get spawning escapements safely upstream.

Research work continued in all major red salmon producing areas of Bristol Bay through coordination of the Fisheries Research Institute and the Fish and Wildlife Service.

The Institute maintained its industry-sponsored studies of the Ugashik and Wood River reds gathering data primarily on seaward migration, spawning escapement, and lake productivity. Commercial catches and escapements to these two areas were systematically sampled for age, sex, and size composition.

Continued for the third consecutive year by the Fisheries Research Institute were the Kvichak studies which were financed by the federal government. The Kvichak is the most important red salmon producing area in Alaska. The Institute sampled the Naknek-Kvichak catch throughout the season to gain information regarding the sexes, sizes, and age classes present in order to contribute to the knowledge of the nature of Kvichak runs as they pass through the fishery. Towers located at Igiugig were used to enumerate a 2,965,000 escapement into Iliamna Lake. Emphasis was placed on developing methods of increasing accuracy and economy. About 6,000 reds were seined as they escaped into the lake, and the daily observations taken, when compared with catch samples, will permit an evaluation of the sex ratio, size, and age composition of the run. More than 4,000 of these fish were tagged to study timing, distribution, and spawning of individual races.

The spawning escapement of 9,000,000 into Iliamna Lake in 1956 appears to have produced good numbers of fry, but environmental studies indicate an increase in the abundance of predators and food competitors of salmon. Development of an annual index of seaward migrating smolts was continued to determine the relationship of known spawning escapements to young produced and to measure marine and freshwater survival as a basis for forecasting future runs. The 1957 catch of 28,000 smolts was a decrease from the 32,000 and 200,000

taken in 1956 and 1955 respectively. Emphasis will continue on improving indexing methods to obtain reliable forecasts.

Fish and Wildlife Service research was expanded during 1957. A new study to develop better methods of sampling the catch and escapement to ascertain the age and size composition of the runs was begun. It has been shown that gill nets select the larger, older fish from the run leaving younger, smaller fish for escapement. Frequent samples were taken from the Egegik and Naknek-Kvichak gill net fisheries and were compared with samples taken from the escapement into these systems. Several methods of sampling fish from the escapement were explored, with beach seining providing the best results. A partial analysis indicates that the Naknek escapement was divided almost equally between progeny of 1951 and 1952 spawning escapements. About two-thirds of the Egegik escapement were produced by the 1951 escapement and one-third by the 1952 escapement.

Tagging studies were concentrated in the Naknek-Kvichak system. Three tagging crews of three men each on a standard Bristol Bay gill net boat captured and tagged red salmon at the lower fishing boundary (fig. 28). Special test set nets recovered tagged fish at the upper boundary as they left the fishery. A total of 9,672 tagged fish was released between June 21 and July 24. By the end of December 3,414 tags were reported from the commercial fishery. Of these, 281 were from Egegik and 28 from Nushagak, 3 from the Ugashik with the remainder taken from Naknek-Kvichak. In addition, 1,272 tags were sighted in Bristol Bay rivers and about 190 were recovered by foot survey parties.

A partial analysis indicates that: (a) About 80 percent of the tags recovered from the Naknek-Kvichak fishery were taken by the end of the second fishing period after tagging; (b) Kvichak fish are available to the fishery longer than Naknek fish. On the Kvichak, 55 percent of tags captured at test set nets on the upper boundary were taken in three or less days. On the Naknek, 72 percent of the test set net recoveries were realized on the third day after tagging (fig. 29); (c) most tagged fish escaping into the Naknek pass the weir in three or less days after entering the fishery; (d) fish tagged during an open fishing period, or at the beginning of a closed period, were recovered from the fishery in fewer numbers than those tagged during the middle or end of closed periods (fig. 30); (e) tag recoveries from the Naknek-Kvichak fishery

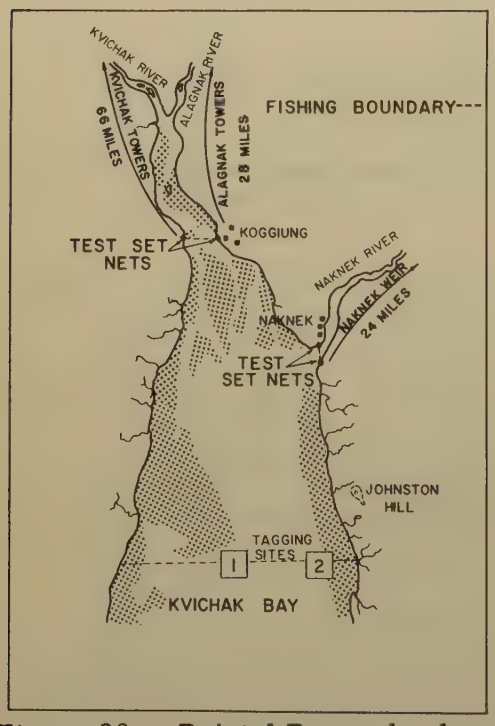


Figure 28.--Bristol Bay red salmon tagging sites, 1957

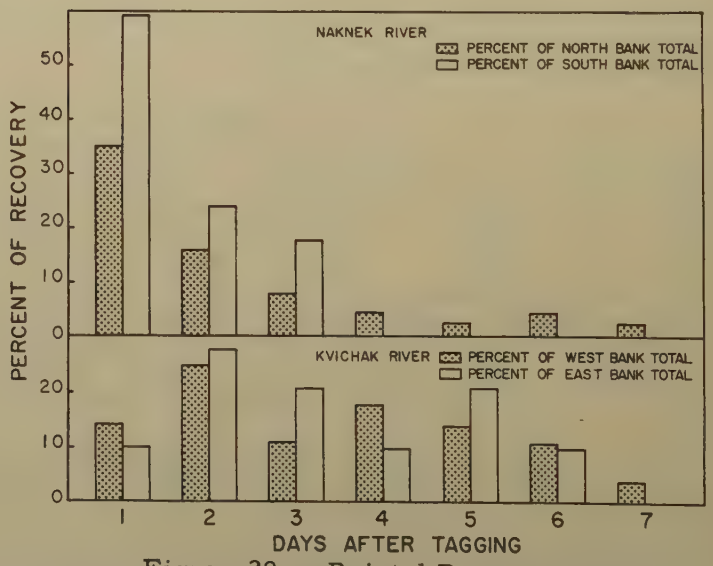


Figure 29.--Bristol Bay test set net tag recoveries, 1957

have been recorded from specific areas of catch and, when fully analyzed, will provide better information on the movements of these fish within the fishery.

Daily test set netting was conducted at the upper fishing boundaries on the Naknek and Kvichak Rivers. The two uppermost commercial set nets on each bank of both rivers were limited to 25 fathoms in length and allowed to fish continously throughout the season.

Primary objectives were: (a) To determine if daily test fishing will provide an index that would indicate the number of red salmon escaping into the Naknek and Kvichak Rivers each day; (b) To recover, as they left the fishery, red salmon that were tagged entering the fishery, thereby indicating the length of time they were available; (c) To obtain daily length and scale samples from fish leaving the fishery to better understand the selective action of gill nets on the catch and escapement; (d) To study the relationship of tidal fluctuation on the migration of red salmon through the fishery.

Catch figures indicate that test net catches fluctuated rythmically with the open and closed periods (fig. 31), but data must be equated to tides and time fishes prior to drawing conclusions.

Tower counting by the Fish and Wildlife Service provided good reliable estimates of escapement into three major tributaries. Weirs were replaced by towers on the Egegik and Ugashik, and escapements were estimated as 341,000 and 206,000 respectively. On the Alagnak (Branch River) an estimate of 129,000 was obtained.

On the Naknek, towers were operated in conjunction with the weir and daily and seasonal estimates of each were compared with favorable results. Partial analysis suggests that another study of the Naknek system is needed prior to replacing the weir with towers.

The behavior of the migrating reds was closely observed at each tower site to learn more about night migration and to develop equipment and methods to simplify enumeration without loss of accuracy.

Fish and Wildlife Service field crews captured red salmon fingerlings in fyke nets to study the characteristics of the seaward migration and to develop sampling techniques that will permit reliable estimates of the number, age, and size of the smolt.

On the Naknek a cross-section of the entire river was sampled each day from late May to early August. About three million smolts were estimated to have migrated as

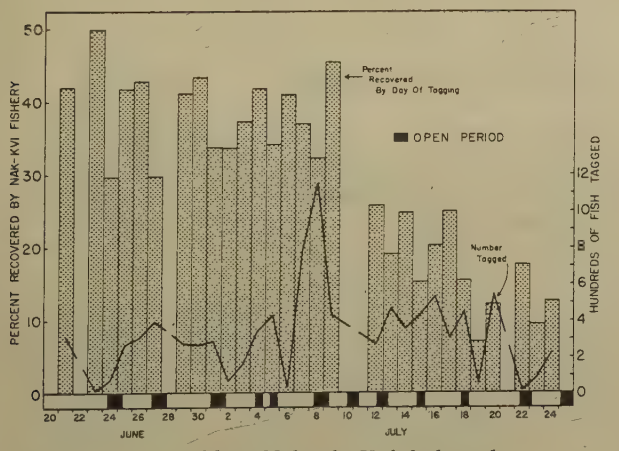


Figure 30.--Naknek-Kvichak red salmon tagging, 1957

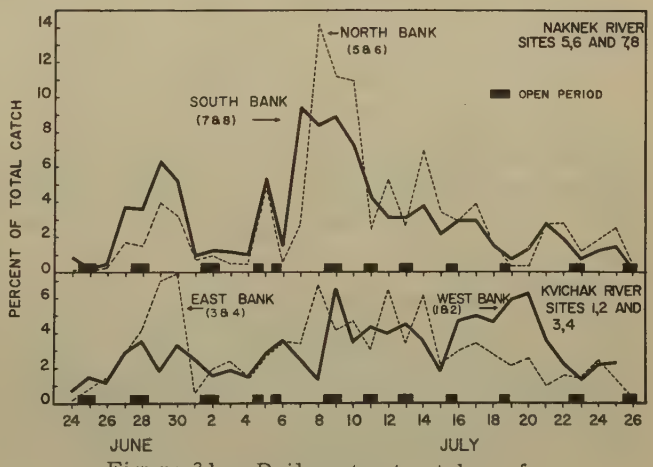


Figure 31.--Daily set net catches of red salmon, Bristol Bay, 1957

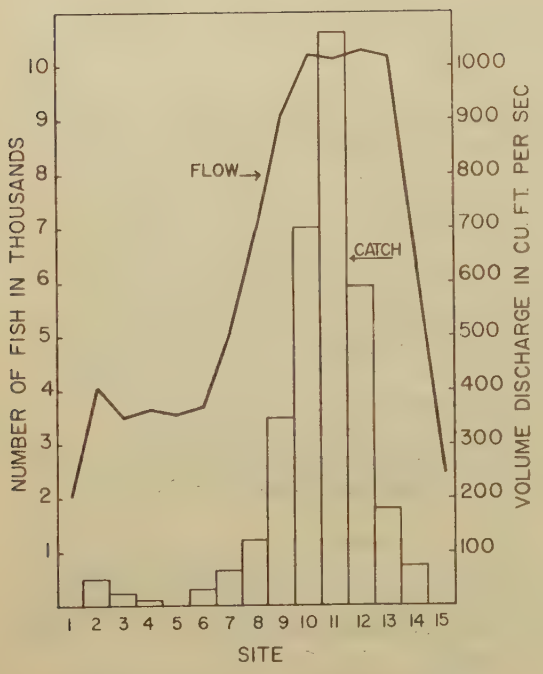

NUMBER OF FISH IN THOUSANDS
VOLUME DISCHARGE IN CU. FT. PER SEC
FLOW
CATCH
SITE
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
100 200 300 400 500 600 700 800 900 1000

Figure 32.--Naknek River total red salmon smolt catch by fyke net site, 1957

compared to about six million in 1956. The number of fingerling caught at a given site appeared to be related to the volume of water (fig. 32). Catches were made during every hour of the day, but most fish migrated between 10:30 p.m. and 4:30 a.m.; and 7:30 a.m. and 10:30 a.m. On the Egegik, the duration of the run was much shorter than on the Naknek, with peak numbers appearing May 30 and June 3. The young fish were very large and vigorous. Smolt age and size composition data were taken as well as air and water temperatures, water transparency, volume of flow, and other related data.

Another new Fish and Wildlife study obtained information on the fishery resources north of Bristol Bay. From early July through August, a five-man crew conducted aerial surveys and interviewed local people between Cape Newenham and Point Hope. Results of the surveys and interviews, along with data obtained from past records, indicate that the native population is dependent upon salmon and other fishes for much of their food. It is roughly estimated that about 23 million pounds of salmon may be taken and utilized annually by native residents.

The long-term research program at Brooks Lake (Naknek River system) was continued and expanded. Investigations at Brooks are designed to determine the basic factors which affect the abundance of red salmon during their freshwater life, with the ultimate objectives of producing more red salmon.

In 1957, in addition to the collection of regular hydrological and climatological data, two major projects were initiated as well as several minor ones. These projects were, first, the development of a practical technique for measuring primary productivity of red salmon lakes by means of radioactive Carbon 14 tracers, and second, intensive detailed observations of spawning behavior in Brooks River, a major producer for the Naknek River system.

No final results on the primary productivity research are yet available since the final laboratory steps in the technique are still in progress.

A Forecast of the 1958 Bristol Bay Red Salmon Abundance

Our present forecasts of Bristol Bay red salmon runs are at the best "educated guesses" because data are not yet available upon which to base forecasts that have reliable mathematical limits. An interpretation of the history of parent escapements and recent trends of abundance offers the best basis of predicting the strength of the 1958 runs.

For the Naknek-Kvichak our estimate is that the 1958 run will be smaller than the 8 million of 1957. The Nushagak has declined since 1948 and the poor escapements of 1953 and 1954 cannot be expected to produce a bigger run than the 1957 one of slightly over a million. For the Egegik, a greater than average run (1.5 million) is not to be expected. On the Ugashik, the 1952 and 1953 escapements were average and 350 thousand above average respectively; so an average (1.3 million), or above average run may be expected in 1958.

HERRING

The herring reduction fishery in 1957 continued its upward trend for the third year. The season's total catch by the reduction fishery was 57,338 tons as compared to 51,310 tons taken in 1956. The overall catch approached the Alaskan production average for the past 30 years (fig. 33).

The new year class entering the fishery was not strong, and in all fishery districts the catch this year, as last, was dependent upon a single age group. As figure 34 indicates, fish in their fourth year made up about 80 percent of the catch.

In spite of the natural mortality which reduced the numbers of the dominant year class, the catch per boat-ton day remained high. Thes seasonal average of this unit, which is one index of abundance, increased in 1957 for Prince William Sound, remained the same on Kodiak, and dropped somewhat in Southeastern Alaska.

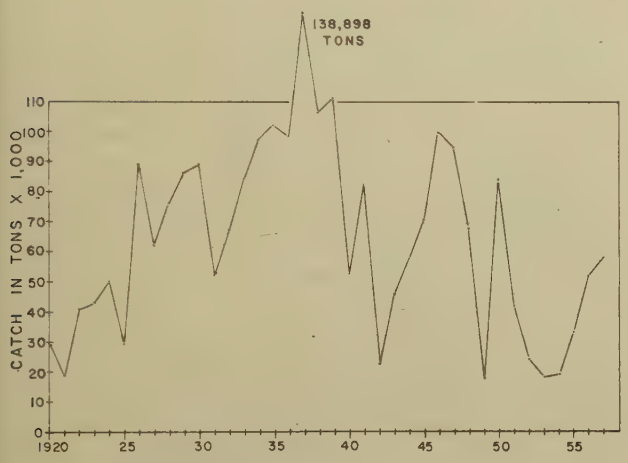


Figure 33.--Total Alaskan herring catch

The herring fishery of Alaska, as in similar fisheries throughout the world, is dependent upon the presence of one or more dominant year classes. These good spawning survivals usually appear as two-year-olds in the fishery. As previously shown (fig. 34), there has been no evidence of a strong entering year class in next year's fishery, and the present stock of three-year-old fish is not conspicuously evident. Unless a strong new age group enters

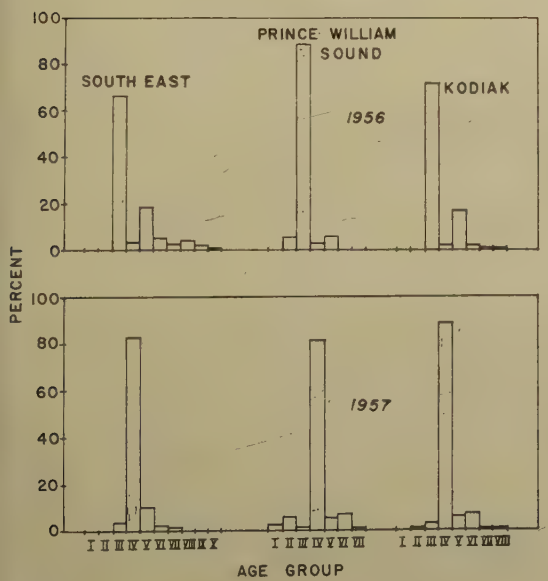


Figure 34.--Alaskan herring - percentage age composition

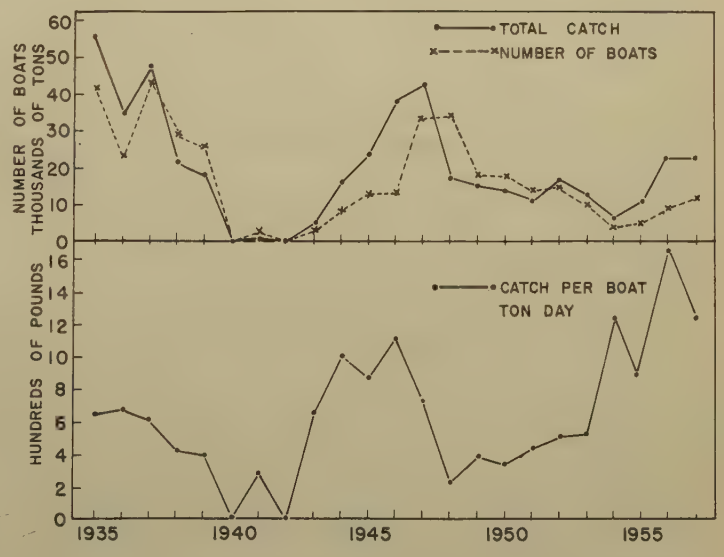


Figure 35.--Southeastern Alaska herring fishery catch, boats, and effort

the fishery, the industry will again be dependent upon the 1953 year class, which as five-year-olds are expected to be about 25 percent less abundant numerically in 1958 than in 1957. However, this will be offset somewhat by an increase in the size of the individuals.

The catch, catch per unit of effort, and number of boats for Southeastern Alaska are shown in figure 35. Although fishing started slowly with the catch per boat-ton day down, by July 21 (period 6), when the 22,500-ton quota was reached in Southeastern Alaska, the catch per boat-ton day greatly exceeded the seasonal average (Figure 36).

Spawning surveys by the Fish and Wildlife Service were extended in 1957, and good coverage of all beaches in Southeastern Alaska was obtained. These surveys provide an indication of the relative size of the herring spawning population. In 1957 the spawning was about the same as in 1956, both years being exceptionally good. A total beach mileage of 132 was located this year as compared to 148 miles in 1956. This difference is not considered statistically significant. As figure 37 shows, there are three major spawning areas, possibly only one of which contributes to the present fishery.

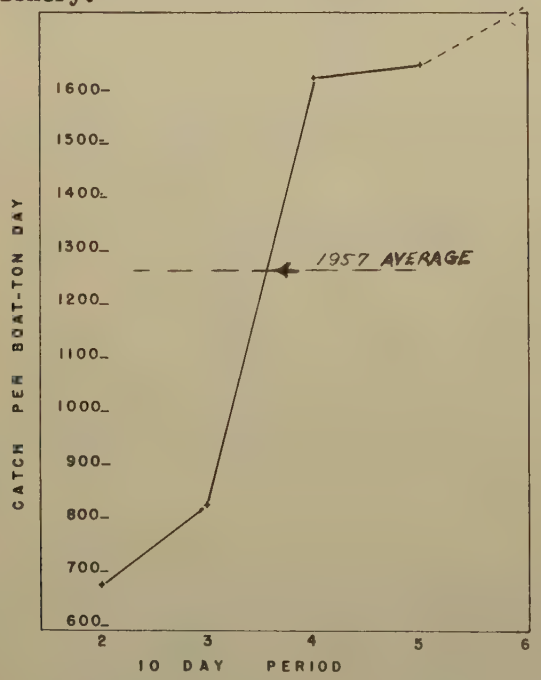


Figure 36.--Catch per boat-ton day Southeastern Alaska herring fishery, 1957

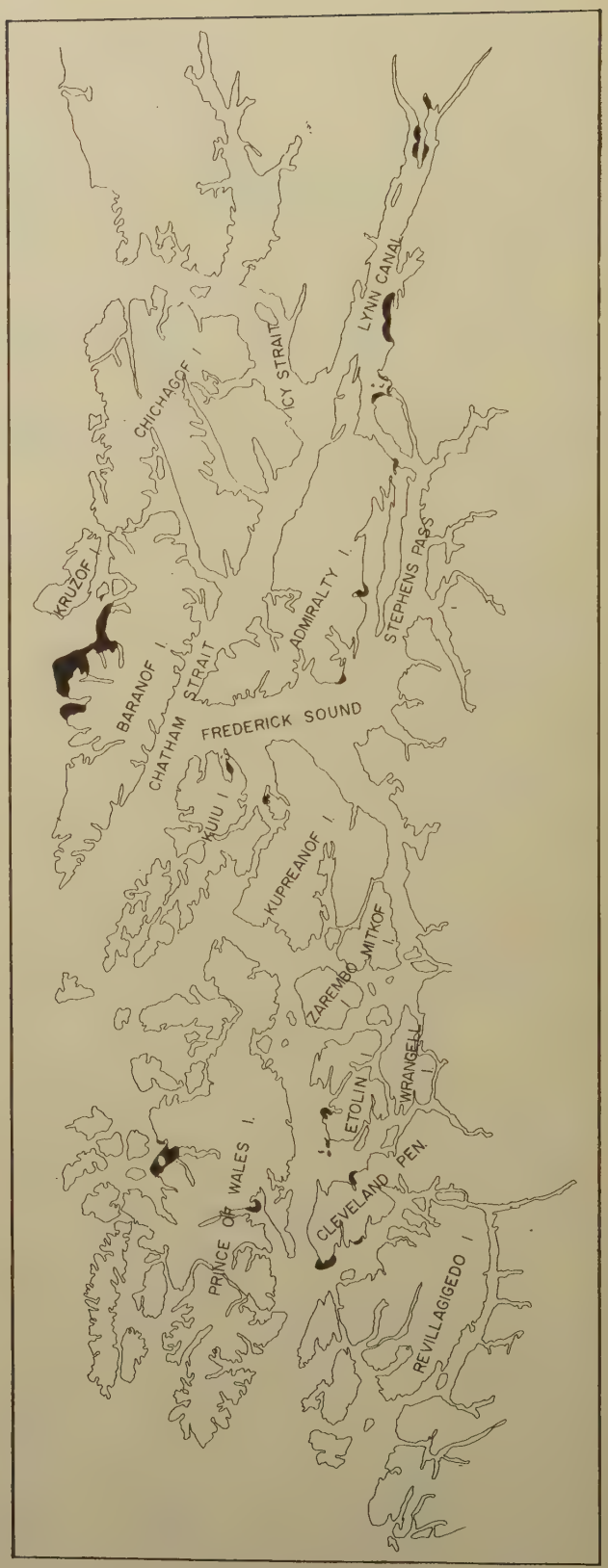


Figure 37.--Herring Spawning Areas in Southeastern Alaska, 1957

KING CRABS

There are three major king crab fishing districts in Alaska. Of these Kodiak and the Sand Point-Cold Bay region are areas offall and winter fishing while the Cook Inlet fishery (mainly in Kachemak Bay) is carried on in the summer. The king crab landings in pounds for the 1954, 1955, and 1956 fishing seasons are as follows:

	Cook Inlet	Kodiak	Sand Point
1956	2,072,679	4,126,793	2,043,967
1955	1,972,177	2,394,611	1,640,688
1954	1,271,825	4,764,315	316,660

The crab industry in Alaska has expanded to such an extent that a study of the various crab populations and their biology is necessary in order to know how much expansion may occur without overexploitation. The widespread distribution of the fishery has resulted in crab investigations developing along several lines and in different regions. Studies on the king crab are being conducted by the Fish and Wildlife Service; and, under contracts with the Service, king crab studies are also being conducted by the University of Southern California, the University of Washington, and the Alaska Department of Fish and Game. Coordination of the contracts of the various agencies is accomplished by the Service. The studies are being conducted in Cook Inlet, Kodiak, and the Sand Point-Shumagin region.

In Cook Inlet, crab studies are being conducted by the University of Southern California and the Fish and Wildlife Service. The University's contract investigations concern the biology of the king crab, while the Service's program involves a study of the fishery.

Several thousand tagged crab have been released and measurements of the size composition of the crab catch are underway.

SHRIMP

Alaska's shrimp production continued to be limited for economic rather than biological reasons. Although a small shrimp pack originates from Cook Inlet, Southeastern Alaska continues to produce the major portion of the pack. The product in pounds for 1954 through 1956 in Southeastern Alaska has been:

1956	3,031,598
1955	1,777,122
1954	1,437,924

This year the schooner TORDENSKJOLD, under charter to the Fish and Wildlife Service, found excellent shrimp fishing in the waters between the Alaska Peninsula and the Shumagin Islands. For example, three 30-minute drags off Pavlof Bay produced a total of 8,460 pounds of shrimp.

ALASKA CANNED SALMON PACK
In cases*
PRELIMINARY REPORT FOR 1957

SOUTHEASTERN ALASKA

District	Kings	Reds	Cohos	Pinks	Chums	Total
Ketchikan	282	17,762	12,628	120,183	104,410	255,265
West Coast	41	13,654	10,908	131,121	20,520	176,244
Central	681	10,880	7,216	60,292	51,997	131,066
Eastern	61	2,274	679	20,324	24,888	48,226
Western	159	21,294	6,373	54,336	97,614	179,776
Icy Strait	343	16,412	15,763	18,325	63,550	114,393
Total - Southeast Alaska	1,567	82,276	53,567	404,581	362,979	904,970

CENTRAL ALASKA

Copper River	149	2,317	412	--	--	2,878
Prince William Sound	2,173	53,594	10,853	35,477	74,912	177,009
Cook Inlet	13,913	60,314	10,947	18,744	127,950	231,868
Kodiak	75	20,962	3,226	226,775	93,588	344,626
Chignik	137	28,259	422	14,529	21,746	65,093
Peninsula - South Side	667	23,236	3,415	28,668	117,554	173,540
Total - Central Alaska	17,114	188,682	29,275	324,193	435,750	995,014

WESTERN ALASKA

Peninsula - North Side	454	20,093	228	--	7,147	27,922
Bristol Bay	16,285	471,979	4,220	--	23,940	516,424
Yukon	12,564	--	--	--	--	12,564
Total - Western Alaska	29,303	492,072	4,448	--	31,087	556,910
TOTAL FOR ALASKA	47,984	763,030	87,290	728,774	829,816	2,456,894

* Converted to basis of 48 1-pound cans to the case

INT.-DUP. SEC., WASH., D.C. 39493

FROZEN AND CURED SALMON PRODUCTION*

District	Reds	Kings	Pinks	Chums	Cohos	Total
Southeastern Alaska:						
Central				32,852		32,852
Ketchikan				111,874		111,874
Central Alaska:						
Kodiak	104		45,471	24,359	10	69,944
Cook Inlet		118				118
Prince Wm. Sound				26,129	40	26,169
Copper River (Yakataga)					11,454	11,454
Peninsula, South Side	17,725	102	14,579	47,534	664	80,604
Western Alaska:						
Peninsula, North Side	16,111	12	44	3,271	7,294	26,732
Bristol Bay	896,013	24,309		278	4,401	925,001
Yukon		19,466				19,466
TOTAL ALL ALASKA	929,953	44,007	60,094	246,297	23,863	1,304,214

*Number of fish.

HERRING FOR REDUCTION IN 1957 IN TONS

Southeast -- 22,938 Prince William Sound -- 12,582 Kodiak -- 21,818